a capacitor, the power given to the resistor R, which represents the losses of the sensor and communication electronics circuit seen at the input of voltage rectifier, is given by

$$P = \frac{\omega^2 M^2}{R} |i|^2. \qquad [9]$$

Combining Eqs. 8 and 9 we obtain the maximum power that is limited by the regulations:

$$P = \frac{\omega^2 M^2}{R} \frac{16\pi^2}{\frac{N^2 A^2}{r^2}\left[\left(\frac{1}{r^2} - k^2\right)^2 + \left(\frac{k}{r}\right)^2\right]} H_{max}^2. \qquad [10]$$

3. *Experimental*

3.1 Feed coil

The feed coil's dimensions (A = 310mm x 133 mm) were designed to cover sufficient area of the surface of the tire when placed on the wing of the vehicle. The coil was made of 3.2 mm hollow copper pipe to ensure low resistance and low dissipation in the coil. The number of turns of the coil is N = 2.

Table 2 gives the maximum allowed rms current in the coil calculated by using Eq. 8 and also the figure proportional to the transmitted power by using Eq. 10. From this last figure one can conclude that the 6.8 MHz frequency range would be optimal, if the highest allowed current can be realized.

Frequency band [MHz]	Maximum allowed current i[A], N = 2	Maximum RMS voltage [V] @i_{max}	Maximum achievable power [W] in tire (approximative)
6.765 - 6.795	11.23	1010	10

The tire in the experiments is Nokian Tyres Hakkapeliitta 2 (195/65 R15). The table 5 shows how much power we were able to get inside the tire for different feed coil distances from the tire surface. The feed coil was tangential to the surface of the tire, see Fig. 11. The tire was installed to the rim. Minimum and maximum values are given because the induced voltage drops when the feed coil is between receiving coils.

Distance from the tire (cm)	Minimum voltage (V)	Maximum voltage (V)	Minimum power (mW)	Maximum power (mW)
0	12.0	15.7	288	493
5	10.8	13.1	233	343
7.5	8.1	9.4	131	177
10	6.2	7.2	76.9	104
12.5	4.9	5.9	48.0	69.6
15	3.9	4.4	30.4	38.7
20	2.5	2.8	12.5	15.7

Table 5. The amount of rectified power given to a 500 Ω resistor inside the tire for different distances between feed coil and tire surface. Frequency is 6.48MHz. In this experiment only coil 4 is energized.

It should be pointed out, that higher power levels could be achieved if faster power transistors can be found (2SA1258/2SA1259 and 2SC3144/2SC3145, for example).

4.2 Current in the feed coil

From formulas [1] and [3] we obtain the current running through the feed coil by measuring the voltage induced into a test coil. If the area of the loop A is small, we can assume that the density of the magnetic field H generated by the feed coil is constant across this area. We